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ACROCOMIA MEXICANA: PALM OF THE ANCIENT MESOAMERICANS

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ABSTRACT.—Archaeobotanical evidence for the use of *Acrocomia mexicana* (Arecaceae) fruits by prehistoric Mesoamericans is presented in this paper with a focus on recent data from the Copán site. It is a tree of disturbed habitats and one whose frequency has expanded dramatically since the arrival of the first humans in the region. Productivity assessments of *A. mexicana* show that it was capable of contributing considerably to the pre-Columbian diet, expecially in light of the high fat content found in the mesocarp and kernel portions of the fruit.

RESUMEN.—A continuación se presenta la evidencia arqueobotánica del uso de los frutos de *Acrocomia mexicana* (Arecaceae) por algunos habitantes de Mesoamérica prehistorica con un foco sobre información nueva del sitio de Copán. Este es un arbol que se da en ambientes secundarios cuya frecuencia se ha extendido dramaticamente desde la llegada de los primeros hombres a la región. Las medidas de productividad de *A. mexicana* muestran que la misma es capaz de contribuir considerablemente a la dieta pre-Colombina, especialmente en vista del alto contenido en el mesocarpo y porciones del corazón de la fruta.

RESUME.—Nous proprosons de présenter dans cet article les preuves archéobotaniques au suject des fruits *Acrocomia mexicana* (Arecaceae) utilisés par les Mesoaméricains prehistoriques avec un foyer sur la donnée récent de le site de Copán. C'est un arbre qu'on trouve dans des habitats perturbés et dont la fréquence a augmenté de facon dramatique depuis l'arrivée des premiers êtres humains dans la région. Les mesures faites sur la productivite' de l' *A. mexicana* montrent que ce fruit était capable de contribuer considerablement au régime alimentaire des pré-Colombiens, particulièrement en vertu du taux élevé en lipides contenues dans le mésocarpe et le noyau du fruit.

INTRODUCTION

It has long been supposed that the prehistoric Maya and other pre-Columbian Mesoamericans relied on more than just the often cited trinity of corn, beans and squash for their sustenance. Recent analyses of carbonized plant remains from the Copán site in western Honduras and other prehistoric sites in the region have revealed the presence of numerous economic species in archaeological deposits. Among these have been the remains of coyol (*Acrocomia mexicana* Karw. ex Mart.), a useful palm that is indigenous to the Neotropics.[1]

The common name for this tree among Mestizos throughout Central America, "coyol," is of Nahuatl origin (Standley and Steyermark 1946). The Yucatec Maya call it "tuk," (Roys 1931), while other Native American names for coyol include: "maap" (Teenek Maya)(Alcorn 1984), "ya cul" (Jicaque)(Lentz 1986) and "ača" (Paya)(Conzemius 1927).

USES OF COYOL

Today coyol is found in many parts of Central America and is commonly cultivated by Mestizos (Moore 1961). The globose fruits (3–4 cm in diameter) mature in six months and are composed of four layers: (1) the thin outermost layer or pericarp, (2) the thick, fleshy mesocarp just underneath, (3) the hard, bony endocarp and innermost, (4) the solid, white kernel or endosperm which is similar to the meat of a coconut (Fig. 1).

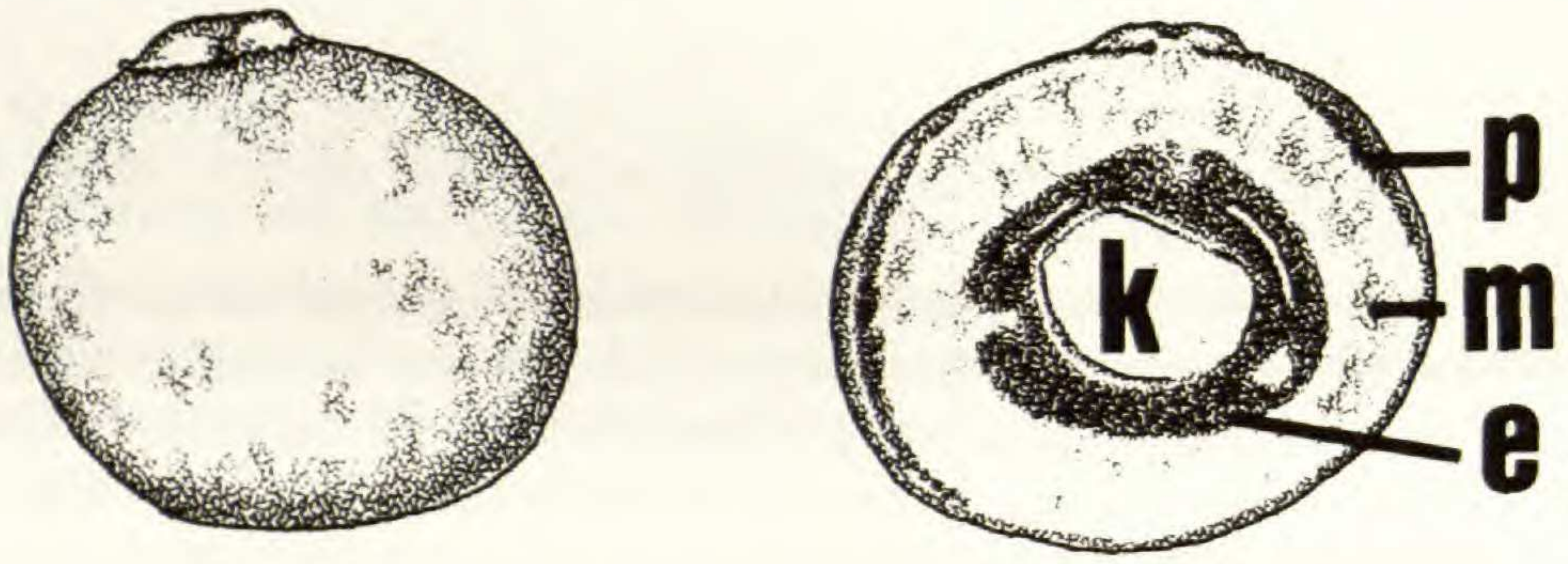

FIG. 1.—Scale drawing of *A. mexicana* fruit showing the exterior (left) and a transverse section showing tissue layers (right) with k = kernel or endosperm, e = endocarp, m = mesocarp and p = pericarp.

The use of coyol products has been documented for people throughout Mesoamerica. The Teenek Maya routinely spare palms that volunteer in their milpas because they value the fruit (Alcorn 1984:421). The fruit of coyol, especially the inner meat, is eaten fresh (Alcorn 1984:375) or sometimes stored in pots for later use (Alcorn 1984:128). The Yucatec Maya eat coyol kernels fresh too, and make a drink from it (Tozzer 1941:200; Roys 1931:288). According to Roys quoting the Relaciones de Yucatan:

> ... the Indians [Maya] roast them [coyol] in stew-holes and eat the pulp [mesocarp] which is on the pit. They also cook it in honey. The pit has a kernel like a very palatable hazel-nut, and this is a great benefit to the Indians in times of scarcity, because there is a great quantity of them, and they make a food and a drink which is healthy and very sustaining. [Roys 1931:288]

Roys also mentions that coyol was used as part of a remedy for blood in the urine and diabetes. For a discussion of medicinal uses for South American *Acrocomia* palms see Plotkin and Balick (1984). The Jicaque Indians of Montaña de la Flor, Honduras, have similar uses for coyol and often plant the trees in their house compounds (Lentz 1986). The Paya Indians of El Carbón, Honduras, eat coyol fruits and make a wine from the sap of felled trees. A complete description of the process for making coyol wine can be found in Balick (1990). Likewise, Central American Mestizos consume the fruits and other coyol products. In addition to fresh consumption, wine-making, and medicinal applications, *Acrocomia* palms are good sources of oil which can be extracted from the kernel (Williams 1981:249–250) and the mesocarp (Plotkin and Balick 1984).

To get to the kernel, the bony endocarps are generally cracked open between two large stones (Standley and Steyermark 1946:201–202). Large "nutting stones" with 2–3 cm depressions have been discovered in at least two Honduran archaeological zones, Cajón and Copán (Fea. 75, Str. 9N–97). Since these would have made ideal anvils for cracking coyol "nuts," they can be considered circumstantial evidence of early coyol processing.

ARCHAEOBOTANICAL EVIDENCE

Early evidence of palm use has been found throughout the subcontinent: from Panama to Mexico (Fig. 2). The earliest report of *A. mexicana* came from the Tehuacan Valley sites, circa 4,800 B.C., in Central Mexico (Smith 1965). Other Mesoamerican archaeological sites where palm remains have been discovered are listed in Table 1.

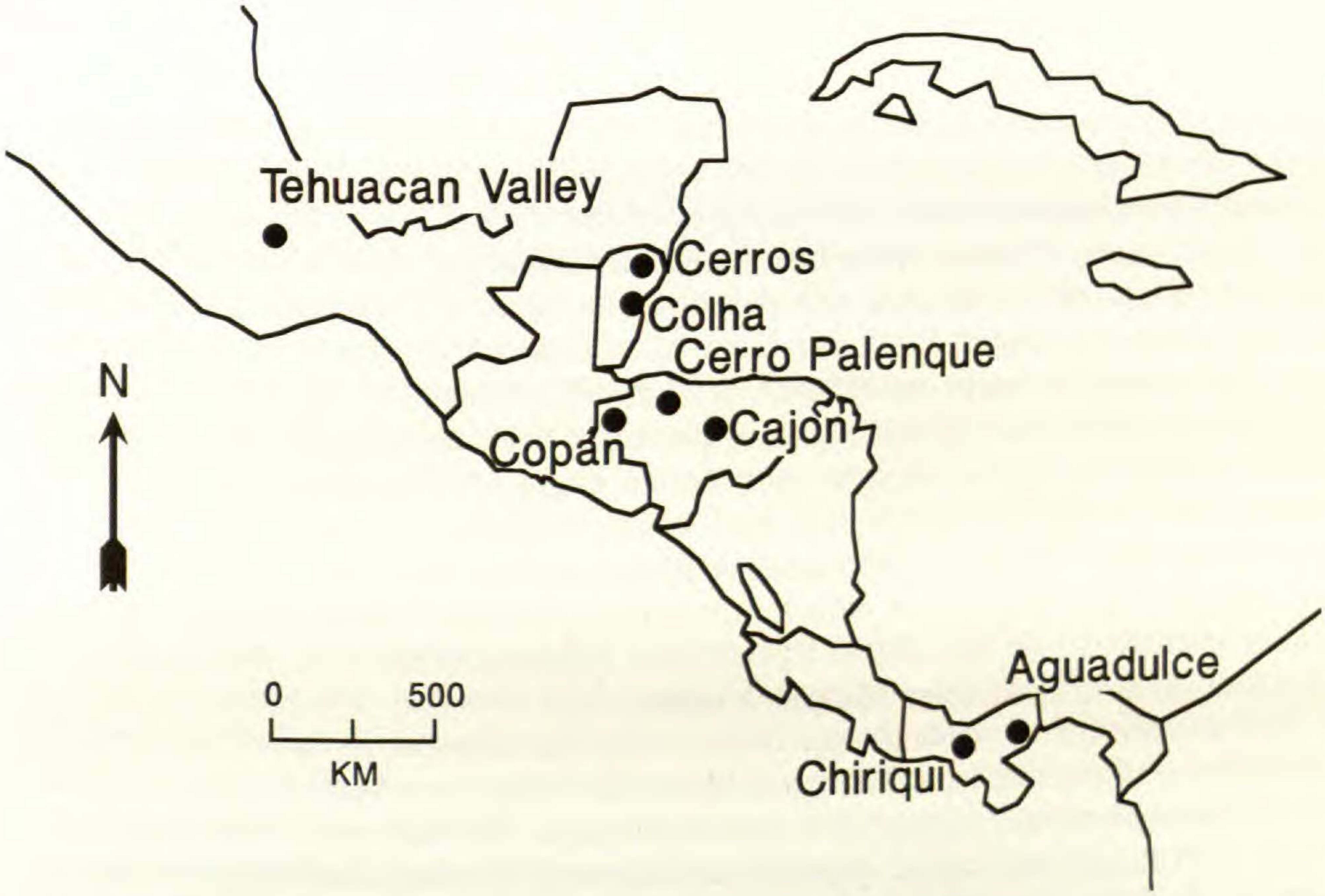

FIG. 2.—Map of Mesoamerica showing archaeological sites where palm remains have been found.

TABLE 1.—*Mesoamerican archaeological sites with palm remains.*

Site	Date	Palm	References
Cerros, Belize	200 B.C.–A.D. 100	*Acrocomia mexicana* fruits	(Crane 1986)
Colha, Belize	A.D. 900–1,200	*A. mexicana* "shells"	(Caldwell 1980)
Cerro Palenque, Honduras	A.D. 600–900	"coyol remains"	(Joyce 1985)
Copán Valley, Honduras	A.D. 400–900	*A. mexicana* endocarps	(Lentz 1990)
El Cajón region, Honduras	200 B.C.–A.D. 900	*A. mexicana* endocarps	(Lentz 1989)
Tehuacan Valley, Mexico	4,800 B.C.	*A. mexicana* endocarps	(Smith 1967)
Aguadulce Shelter, Panama	5,000–1,000 B.C.	"palm nuts"	(Ranere and Hansell 1978)
Chiriqui, Panama	4,600–2,300 B.C.	*A. mexicana* endocarps	(Smith 1980)

In the Copán Valley, *A. mexicana* has been identified from the Ostuman site, the Los Mangos site, several small upland sites, and has been found in association with numerous structures in the Sepulturas section just east of the Main Group; the principal ceremonial complex of the Valley. All of the outlying sites are Late Classic (Coner Phase) in temporal affiliation, but in the Sepulturas section, much earlier occupational components have been found underlying the Coner Phase material. Carbonized plant remains have been analyzed from deposits dating as early as 900 B.C. (Gordon/Uir Phase).

Table 2 shows the chronological sequence of the various occupational phases encountered during the Copán excavations along with the number of archaeobotanical samples analyzed from each phase and the number of samples bearing coyol. The lack of coyol remains found before the Late Bijac/Early Acbi Transition Phase (circa A.D. 400) is interesting because it coincides with the first Maya intrusion into the Copán Pocket and approximately with the erection of the first stela in the valley (Sanders 1989).

There are three possible explanations for the absence of coyol prior to the Acbi Phase. First, but least likely, coyol remains may have been deposited in the earlier strata but not preserved. Coyol endocarps, the fruit part most frequently recovered in archaeological deposits, are among the most durable plant tissues to be found. It is also the part of the coyol fruit which is of little use and routinely discarded. The cell structure of the endocarp has a high density and, consequently, the tissue layer is very hard. Other less durable remains, such as corn cupules,

TABLE 2.—*The chronological sequence from Copán Valley excavations along with the number of archaeobotanical samples bearing A. mexicana remains.*

Occupational Phase	No. samples analyzed	No. samples with coyol
Coner phase (Late Classic) A.D. 700-900	168	74
Acbi phase (Middle Classic) A.D. 400-700	17	5
Bijac/Acbi transition A.D. 400	5	4
Bijac phase (Early Classic) A.D. 100-400	4	0
Chabij phase (Late Preclassic) 400 B.C.-A.D. 100	0	0
Gordon/Uir phase (Middle Preclassic) 900-400 B.C.	14	0

are found frequently in the Bijac and Gordon Phase deposits so even a minor utilization of coyol should have appeared in the archaeobotanical record.

Second, perhaps coyol was available in the Copán Pocket but not exploited by the pre-Maya population. It seems unlikely that the pre-Maya of Copán would have had a useful tree in their midsts and not exploited it, at least to some degree. It is possible that they had a different pattern of utilization, such as cracking open the drupes in the field, then consuming the kernel directly or perhaps bringing only the kernels back to the habitation site for consumption. As a result, the endocarp would not have been deposited at the site. This pattern of use does not allow for the use of the mesocarp, since this later generally requires more processing than the kernel, nor does it allow for storage, since the exposed kernels do not store well. Alternatively, the fruits store extremely well when left in their own natural package. If the fruits were being used and stored, then the waste portions would likely have been found in or around the habitation site. Here again, even a minor use of coyol by the pre-Maya should have produced some evidence in the archaeobotanical record.

The third and most reasonable explanation is that the Maya introduced the use of the plant into the area and possibly even brought the seeds with them. During Early Classic times the Copán Pocket was an extremely isolated area, a veritable cultural backwater probably similar to what it was like when Stephens (1963) arrived in the mid-19th century, minus the ruins, with small populations surrounded by dense stands of tropical deciduous forest. Sanders (1989) states that the Preclassic population of the valley was probably less than 1,000 people and seems to have remained that size until the Maya intrusion at the beginning of the Acbi phase (Webster and Freter 1989). Since the Copán Valley is so remote, it seems plausible that coyol may not have migrated into the valley by means of its own dispersal mechanisms.

The natural habitat of coyol is unclear. In general, the palm is adapted to disturbed habitats (Moore 1979) and grows rapidly, eventually reaching a height of up to 15 meters. It will bear abundant fruit after 4–5 years as do its congeners (FAO 1949). Notwithstanding its characteristics as a pioneer species, it is curiously absent from traditionally recognized disturbance sites such as creek bottoms and river banks (Janzen 1971). Coyol does not compete well under constantly wet conditions as would be found in an active alluvial plain (Uhl and Dransfield 1987) and prefers well-drained areas. Slopes cleared for agriculture and open savannas are common habitats for coyol today. On the Pacific Coast, the palm will form forests of large extent, called "coyolares," but these are less common on the Atlantic Coast (Standley 1937). Cattle enjoy coyol fruits and are at least partially responsible for the widespread distribution of the palm today (Janzen 1971; Uhl and Dransfield 1987). Local farmers claim that deer also eat and disperse coyol fruits, but, if so, it must be an excruciatingly painful exercise for these small ungulates.

Although coyol does not seem to grow in disturbed habitats along streams, there are other suitable disturbed micro-habitats in even the most stable forest environments. In the case of tropical deciduous forest, which was the dominant vegetation in lowland areas during pre-settlement times for much of Central America, there must have been episodes of disturbance caused by natural calamities such as forest fires or storms causing uprooting of large trees. Such events would have opened the forest canopy and given a fast-growing species like coyol a chance to become established and set seed before being crowded out by forest dominants.

When early agriculturalists entered the region in prehistoric times, they created additional areas of disturbance and undoubtedly contributed to is expansion. Probably this occurred unintentionally at first, but as the useful properties of the plant became apparent, humans may have become more active in dispersing the seeds of coyol. Smith (1975), in a discussion of the distribution of coyol, states that its presence on both the Atlantic and Pacific Coasts of Mexico is best explained as a direct result of human activity. In any case, man has certainly played a major role in the expansion of coyol populations into new areas.

DISCUSSION

Copán provides a good example of the role coyol could have played in the prehistoric Mesoamerican dietary pattern since the valley and its prehistory have been so well studied. The drainage basin covers about 400 km^2 but, of these, only 60 km^2 can be used for maize-based agriculture (Sanders 1989). Sanders has described four landtypes suitable for agricultural production in the pocket: active alluvium, ancient alluvium, intermontane basins, and piedmont. All of these, except for the active alluvium, would have been excellent habitat for coyol following forest clearance.

Phenological data collected by the author from several locations in Honduras indicate that the fruit is produced twice a year, with the first seedfall occurring in May through June and the second in November through December. Coyol becomes ripe at the end of the second dry season when food sources are most limited in this region. Accordingly, it would have been an excellent famine food—a feature that surely must have enhanced its value.

To determine the productivity of coyol, three fields were selected to represent a range of coyol density where they were not cultivated or planted, but allowed to grow as volunteers. The first plot, a pasture at the Centro Nacional de Granaderia de Comayagua, Honduras, appeared sparsely populated with coyol (Table 3). The second plot, a cornfield at the Centro, showed medium coyol density. Both plots were located on an alluvial terrace at about the same elevation (600 m) as the floor of the Copán Valley. The third plot was a fallow field in the Copán Pocket on a moderate slope in the Rio Gila drainage. This represents an area with high coyol density. The palms in each plot were counted and the fruiting inflorescences from two trees in each plot were harvested (Table 4).

TABLE 3.—*A. mexicana trees per hectare (ha) from three Honduran fields. The first two plots were in the Comayagua Valley and the third was in the Gila Valley of the Copan Pocket.*

Field	Area (ha)	Total Trees	Trees in Fruit	Fruiting Trees/ha
1	0.8	4	3	3.8
2	2	14	8	4
3	1.75	46	24	13.7
				Avg. = 7.7

A nutritional analysis of coyol mesocarps and kernels was conducted on mature fruits taken from the Copán Valley (Table 5). The fruits have high caloric contents: 6,600 calories/kg for the kernel and 5,610 calories/kg for the mesocarp. This compares very favorably to other foods, such as maize which produces 3,610 calories/kg (Webster 1981:920). The high fat content of coyol is responsible for the prodigious caloric value. Protein, at least from the kernel, is also in good supply at 14.62% by weight.

When these data are combined, an estimate, albeit a rough one, of coyol productivity can be derived. An average coyol palm will produce 493 fruits/tree (Table 4), or, given that two harvests per year can be obtained, 986 fruits/tree/year. If data from Table 5 are included, an average tree can be shown to produce 5.57 kg/tree/year of edible fruit. We can multiply the amount of land suitable for coyol (4490 ha) times the average number of trees per hectare (7.7) times the average number of fruits per year per tree (986) and a result of over 34 million fruits per year is obtained. Going back to Table 5 to enter the number of calories per fruit (32.34), we can calculate the number of calories per year for coyol (total = approximately 1.1 billion calories/year). These figures are based on

TABLE 4.—*A. mexicana fruit production per tree. Trees number 1 and 2 were from the first Comayagua Valley field, 3 and 4 were from the second Comayagua Valley field and 5 and 6 were from the Copán Pocket.*

Tree	# Inflorescences	# Fruits
1	5	660
2	2	842
3	2	464
4	1	329
5	2	276
6	3	386
Total	15	2,957
Average/tree	2.5	493
Average/tree/year	—	986
kg edible fruit/tree/year	5.57	

TABLE 5.—*Nutritional data for A. mexicana kernels and mesocarps. Being of doubtful food value, the other tissue layers of A. mexicana fruits, i.e., the endocarp and the pericarp, were not analyzed.*

Component	Kernel	Mesocarp
Avg. wt./fruit (air dried), g	0.65	5.00
Protein, %	14.62	3.29
Fats, %	44.28	34.92
Carbohydrates, %	18.86	40.21
Fiber, %	14.59	8.26
Ash, %	2.88	3.69
Water, %	4.77	9.63
Calcium, mg/g	0.08	1.05
Phosphorus, mg/g	0.03	0.16
calories/g	6.60	5.61
calories/fruit	4.29	28.05
Total calories/fruit	32.34	

current usage practices where coyol is merely allowed to grow when it volunteers and is not actively cultivated.

At its hypothesized maximum, 20,000 people lived in the Copán Pocket during the Coner phase (Sanders 1989). If 2,200 calories (see Dickson 1980:704) are required per person per day, then 16.06 billion calories would have been required annually to sustain the Copán population at its peak. Accordingly, coyol could have supplied about 7% of the calories needed during the high point in the demographic trend of the Coner phase and even more if the palms were actively planted and cultivated. Furthermore, this production could have been achieved with relatively little impact on the corn or other major crop harvests.

Coyol fits very well into the infield/outfield agricultural model described by Netting (1977) and Flannery (1982). The outfields are large extensive plots planted away from the habitation site, usually in monoculture with a grain, in this case corn, as the principal crop. The outfields are managed with relatively low labor input per unit area and are used on a cyclical basis with planting episodes following fallow periods. Slash-and-burn techniques can be used to prepare the fields while variations on the main theme, such as intercropping (more than one crop in a field at the same time) and multicropping (different crops in the same field at different times) can also be employed.

Infields are located adjacent to the house compound and managed intensively with a variety of fruit trees and garden crops being the main producers. It is possible for these small plots to have been utilized year in and year out, but kept fertile with household refuse. In the outfields, coyol may have been treated just as the modern Mestizos do today by cutting around it when they clear the fields and allowing it to grow after it volunteers. In the infields, coyol could have been planted just as the Jicaque do to provide a source of fruit next to the houses. Another fruit-bearing tree, ramon *(Brosimum alicastrum* Sw.), has been proposed (Puleston 1982) for this anthropogenic niche in prehistoric times, but as yet, little archaeobotanical evidence has been found to corroborate this assertion.

Since coyol sap can be used to make wine, perhaps the early Maya were interested in the more stimulating products of this economic species. "Balche," an intoxicating beverage made from a mixture of *Lonchocarpus longistylus* Pittier bark and honey was consumed by the Maya as a ceremoial beverage (Roys 1931: 216). Possibly coyol wine was used in a similar fashion. It is conceivable that the Maya brought in coyol for wine-making, then made greater use of the fruits as demands on local resources increased.

Perhaps the most important feature of coyol is the high fat content of the fruits. Today, most Central Americans use the fat of domesticated animals for their cooking needs. This was not available in pre-Columbian times and there were not many options in terms of oil sources. Moreover, it seems reasonable to suggest that coyol fit into the dietary pattern as a dependable source of fat and/or cooking oil.

In the case of the Copán Maya, populations in the valley seem to have grown considerably during the Coner Phase. According to general productivity estimates (Sanders 1989), the population of 20,000 at its zenith would have exceeded the carrying capacity of the valley, even if all of the available arable land had been brought under cultivation. In such a situation, expanding the use of coyol and other weedy, but edible plants would have been a way, at least temporarily, to increase yields when traditional cultigen production employing slash-and-burn techniques had already been maximized.

CONCLUSIONS

A. mexicana was used and distributed by prehistoric Native Americans from Mexico to Panama. Its high fat content probably made coyol attractive as a source of cooking oil, although its value as fresh fruit or as a source of wine could have been exploited, too. Coyol may well have been cultivated in prehistoric times and it undoubtedly assumed a larger role during times of famine or when populations exceeded carrying capacities, as with the Late Classic Maya of Copan.

NOTE

[1] At least three species of *Acrocomia* have been described for Central America and Mexico: *A. mexicana*, *A. vinifera* Oerst. and *A. belizensis* Bailey. However, the taxonomic boundaries among these species are not clearly defined such that these taxa are indistinguishable to many botanists and may represent synonyms for the same plant (Standley 1937; Standley and Steyermark 1946; Williams 1981). For the purposes of this article, they will all be treated as *A. mexicana*.

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The Healing Forest: Medicinal and Toxic Plants of the Northwest Amazonia. Richard Evans Schultes and Robert F. Raffauf. Forward by HRH the Duke of Edinburgh. Portland, Oregon: Dioscorides Press, 1990. Pp. 484. $59.95 + $3.00 postage and handling.

This is an impressive and valuable volume which promises to be the standard reference work on its subject for many years to come. The book covers the medicinal, hallucinogenic, and poisonous plants of eastern Ecuador, northeastern Peru, southeastern Colombia, northwestern Brazil, and the southern tip of Venezuela. It contains taxonomic, ethnobotanical, and pharmacological information on 1516 species used by native peoples of the area. Many plants are represented by photographs or line drawings. The book is extremely authoritative and well-referenced.

The book does have a few minor limitations. No descriptions of the plants are given, only references to the original technical diagnoses. These are often scanty and sometimes difficult to obtain. Perhaps references to more recent taxonomic monographs would have been more useful. An index to the innumerable native names given in the work would also have been helpful. The discussions of uses and pharmacological properties is very uneven, but this reflects our present state of knowledge.

This book will be extremely useful to pharmacologists seeking new sources of pharmaceuticals. The sheer magnitude of the work, covering one small corner of the tropics, and its explicit acknowledgment of its own incompleteness, should help those seeking to publicize the importance of preventing the destruction of the world's rainforests.

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